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AMENDMENTS TO THE CLAIMS

Please amend the claims as indicated hereafter (where underlining “_” denotes additions and strikethrough “-” denotes deletions).

Claims:

1. (Currently Amended) A method of transcoding a digital stream of compressed frames, the method comprising the steps of:
 - (a) receiving a compressed video frame having content information and non-content information included therein;
 - (b) determining the total compressed size of the frame (N_T);
 - (c) determining from at least the total compressed size of the frame the total number of bits (N_S) to shave ~~from the compressed frame~~;
 - (d) determining a plurality of statistics about a given portion of the frame;
 - (e) determining whether to requantize the given portion based at least in part upon at least one of the statistics about the given portion;
 - (f) responsive to determining to requantize the given portion, requantizing the levels of the given portion;
 - (g) determining whether to threshold the given portion based at least in part on the at least one of the statistics about the given portion;
 - (h) responsive to determining to threshold the given portion, thresholding the levels of the given portion; and
 - (i) transmitting the given portion; and prior to step (h),
determining a target number (N_{THRESH}) of levels to set to zero by
thresholding;
determining the number of levels (CNT) beneath a threshold function
having a predetermined width and height profile;

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responsive to the number of levels (CNT) beneath the threshold function being within a predetermined range of the target number (N_{THRESH}), setting the magnitude of the levels beneath the threshold function to zero; and

responsive to the number of levels (CNT) beneath the threshold function being outside of the predetermined range of the target number (N_{THRESH}), adjusting the threshold function;

2. (Original) The method of claim 1, prior to step (d), further including the steps of:
 - (j) decompressing the video frame into a DCT-domain, wherein in the DCT-domain blocks of pixel information are represented as blocks of levels;
 - (k) parsing the frame into a plurality of portions; andprior to step (i), re-compressing the given portion, wherein the given transmitted in step (i) is the re-compressed given portion.
3. (Original) The method of claim 1, wherein the plurality of statistics about the given portion include the compressed content size (Ssize) of the given portion.
4. (Original) The method of claim 1, wherein the plurality of statistics about the given portion include the average of the quantization parameters used to quantize the levels of the given portion.
5. (Original) The method of claim 1, wherein the plurality of statistics about the given portion include the average of the runs in the given portion.

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6. (Original) The method of claim 1, further including the steps of:
 prior to the step (e), determining the initial compressed content size (S_{int}) of the given portion;
 prior to the step (e), determining a target number of bits to shave (N_{shave}) from the given portion;
 prior to the step (i), determining the final compressed content size (S_{fnl}) of the given portion; and
 calculating the reduction error (e) for the given portion, wherein the reduction error is defined as the difference between the target number of bits to shave and the difference between final and initial compressed content size,

$$e = N_{shave} - (S_{fnl} - S_{int}).$$

7. (Original) The method of claim 6, further including the step of:
 accumulating the reduction error, wherein the accumulated reduction error is used in determining the number of bits to shave from a subsequent portion of the frame.

8. (Original) The method of claim 6, wherein the number of portions in the frame is $N_{portions}$, wherein the given portion is the K^{th} out of the $N_{portions}$ to be processed according to steps (e), (f), (g) and (h), and further including the steps of:
 determining the total compressed content size (C_T) of the frame; and
 accumulating the reduction error for the preceding (K-1) portions;
 wherein the number of bits to shave from the given portion is given by

$$N_{SHAVE} = S_{INT} \times \frac{N_s}{C_T} + \frac{E}{N_{portion} - K + 1}, \text{ where } E \text{ is the accumulated}$$

reduction error for the preceding portions.

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9. (Original) The method of claim 1, further including the step of:
after step (f) and prior to step (g), re-determining at least one of the statistics of the given
portion, wherein the at least one re-determined statistics about the given portion is
used in step (g).
10. (Original) The method of claim 9, wherein the determined statistics include
the compressed content size (Ssize) of the given portion, and the compressed content size
is re-determined after the given portion has been requantized.
11. (Original) The method of claim 1, further including the steps of:
determining a requantization parameter for the given portion based at least upon one of
the determined statistics about the given portion.
12. (Original) The method of claim 11, wherein the given portion was previously
quantized using a first quantization parameter (Q_1), wherein the requantization parameter
(Q_2) is twice the first quantization parameter, $Q_2 = 2Q_1$.
13. (Original) The method of claim 11, wherein the given portion was previously
quantized using a first quantization parameter (Q_1), wherein the requantization parameter
(Q_2) is four times the first quantization parameter, $Q_2 = 4Q_1$.
14. (Original) The method of claim 11, wherein the requantization parameter is
chosen such that the compressed content size of the given portion is reduced by
approximately 60% to 70%.
15. (Original) The method of claim 11, wherein the requantization parameter is
chosen such that the compressed content size of the given portion is reduced by at least
70%.

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16. (Original) The method of claim 11, wherein the given portion is made up of multiple blocks of previously quantized levels, and step (d) includes determining both the maximum quantization parameter (Q1MAX) used in quantizing the previously quantized levels and the average of the previously quantized levels (Lavg), and wherein Q1MAX and Lavg are used in determining the requantization parameter.

17. (Original) The method of claim 11, further including the step of:
determining the picture-type of the video frame, wherein the video frame is an MPEG frame, and the group of picture-types consist of I-Picture, P-Picture and B-Picture, and wherein the picture-type of the video frame is used in determining the requantization parameter.

18. (Canceled)

19. (Currently Amended) The method of claim 18 1, wherein the step of adjusting further includes the step of:
changing the height profile of the threshold function.

20. (Original) The method of claim 19, wherein the height profile is increment.

21. (Original) The method of claim 19, wherein the height profile is decrement.

22. (Currently Amended) The method of claim 18 1, wherein the levels are arranged in order of scan position, and the threshold function extends over a first range of scan positions, and the step of adjusting further includes the step of:
shifting the relative location of the threshold function such that the threshold function extends over a second of range of scan positions.

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23. (Original) The method of claim 22, wherein the smallest scan position included in the first range of scan positions is smaller than the smallest scan position included in the second range of scan positions.

24. (Original) The method of claim 22, wherein the smallest scan position included in the first range of scan positions is greater than the smallest scan position included in the second range of scan positions.

25. (Currently Amended) The method of claim ~~18~~ 1, wherein the threshold function extends over a first range of scan positions, and the given portion is made up of multiple blocks of levels, and the step of adjusting further includes the steps of:

- partitioning the blocks of the given portion into a first group and a second group of blocks;
- associating a second threshold function with the second group, wherein the second threshold function extends over a second range of scan positions;
- (m) determining the number of levels (CNT1) beneath the first threshold function;
- (n) determining the number of levels (CNT2) beneath the second threshold function;
- (o) responsive to the sum of CNT1 and CNT2 being within the predetermined range of the target number (N_{THRESH}), setting the magnitude of the levels beneath the first and second threshold functions to zero;
- (p) responsive to the sum of CNT1 and CNT2 being outside of the predetermined range of the target number (N_{THRESH}), transferring a predetermined number of blocks from the first group to the second group; and
- responsive to the sum of CNT1 and CNT2 being outside of the predetermined range of the target number (N_{THRESH}), repeating steps (m), (n), (o), and (p) until the sum of CNT1 and CNT2 is within the predetermined range of the target number (N_{THRESH}).

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26. (Original) The method of claim 1, wherein the given portion of the frame is a slice of the frame having multiple blocks of levels, and the blocks of levels are thresholded in parallel.

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27. (Currently Amended) An apparatus in a network for transcoding a digital stream of compressed frames, the apparatus comprising:

a decoder adapted to decompress a video frame having content information and non-content information included therein into the DCT-domain, wherein the content-information carried by the frame is represented as levels in the DCT-domain;

a rate controller adapted to receive the video frame, parse the video frame into a plurality of portions, determine a plurality of statistics about a given portion, and determine a target number of bits to shave (N_{shave}) from the given portion;

a requantizer adapted to requantize levels of the given portion;

a thresholder adapted to threshold the given portion, wherein the rate controller determines whether the given portion should be requantized and whether the given portion should be thresholded based at least in part on at least one of the statistics about the given portion; and

an encoder adapted to compress the frame, wherein the compressed size of the frame is approximately the same as a target size;

wherein the rate controller is further adapted to determine a target number (N_{THRESH}) of levels to set to zero by thresholding; wherein the thresholder is adapted to determine the number of levels (CNT) beneath a threshold function having a predetermined width and height profile, responsive to the number of levels (CNT) beneath the threshold function being within a predetermined range of the target number (N_{THRESH}), the thresholder sets the magnitude of the levels beneath the threshold function to zero, and responsive to the number of levels (CNT) beneath the threshold function being outside of the predetermined range of the target number (N_{THRESH}), the thresholder adjusts the threshold function.

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28. (Original) The apparatus of claim 27, wherein the plurality of statistics about the given portion include the compressed content size (Ssize) of the given portion.

29. (Original) The apparatus of claim 27, wherein the plurality of statistics about the given portion include the average of the quantization parameters used to quantize the levels of the given portion.

30. (Original) The apparatus of claim 27, wherein the plurality of statistics about the given portion include the maximum quantization parameter used to quantize the levels of the given portion.

31. (Original) The apparatus of claim 27, wherein the rate controller determines the initial compressed content size, (Sint) of the given portion and the final compressed content size (Sfml) of the given portion, and the rate controller calculates the reduction error (e) for the given portion, wherein the reduction error is defined as the difference between the target number of bits to shave and the difference between final and initial compressed content size, $e = N_shave - (Sfml - Sint)$.

32. (Original) The apparatus of claim 31, wherein the rate controller accumulates the reduction error, and the accumulated reduction error is used in determining the number of bits to shave from a subsequent portion of the frame.

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33. (Original) The apparatus of claim 31, wherein the number of portions in the frame is N_{portions} , wherein rate controller processes the plurality of portions sequentially and the given portion is the K^{th} portion out of the N_{portions} portion to be processed, the rate controller further adapted to determine the total compressed content size (C_T) of the frame, and accumulate the reduction error for the preceding ($K-1$) portions, wherein the number of bits to shave from the given portion is given by

$$N_{\text{SHAVE}} = S_{\text{NT}} \times \frac{N_s}{C_T} + \frac{E}{N_{\text{portion}} - K + 1}$$
, where E is the accumulated reduction error for the preceding portions.

34. (Original) The apparatus of claim 27, wherein the rate controller re-determines at least one of the statistics of the given portion responsive to requantizing the given portion, wherein the at least one re-determined statistics about the given portion is used to determine whether to threshold the given portion.

35. (Original) The method of claim 34, wherein the determined statistics include the compressed content size (Ssize) of the given portion, and the compressed content size is re-determined after the given portion has been requantized.

36. (Original) The method of claim 27, wherein the rate controller is further adapted to determine a requantization parameter for the given portion based at least upon one of the determined statistics about the given portion.

37. (Original) The method of claim 36, wherein the given portion was previously quantized using a first quantization parameter (Q_1), wherein the requantization parameter (Q_2) is twice the first quantization parameter, $Q_2 = 2Q_1$.

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38. (Original) The method of claim 36, wherein the given portion was previously quantized using a first quantization parameter (Q_1), wherein the requantization parameter (Q_2) is four times the first quantization parameter, $Q_2 = 4Q_1$.

39. (Original) The method of claim 36, wherein the requantization parameter is chosen such that the compressed content size of the given portion is reduced by approximately 60% to 70%.

40. (Original) The method of claim 36, wherein the requantization parameter is chosen such that the compressed content size of the given portion is reduced by at least 70%.

41. (Original) The method of claim 36, wherein the given portion is made up of multiple blocks of previously quantized levels, and the rate controller determines both the maximum quantization parameter ($Q1MAX$) used in quantizing the previously quantized levels and the average of the previously quantized levels ($Lavg$), and wherein $Q1MAX$ and $Lavg$ are used in determining the requantization parameter.

42. (Original) The method of claim 36, wherein the rate controller is further adapted to determine the picture-type of the video frame, wherein the video frame is an MPEG frame, and the group of picture-types consist of I-Picture, P-Picture and B-Picture, and wherein the picture-type of the video frame is used in determining the requantization parameter.

43. (Canceled).

44. (Currently Amended) The method of claim ~~43~~ 27, wherein the thresholder adjusts the threshold function by changing the height profile of the threshold function.

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45. (Original) The method of claim 44, wherein the height profile is increment.
46. (Original) The method of claim 44, wherein the height profile is decrement.
47. (Currently Amended) The method of claim 43 27, wherein the levels are arranged in order of scan position, and the threshold function extends over a first range of scan positions, and the thresholder adjusts the thresholding function by shifting the relative location of the threshold function such that the threshold function extends over a second of range of scan positions.
48. (Original) The method of claim 47, wherein the smallest scan position included in the first range of scan positions is smaller than the smallest scan position included in the second range of scan positions.
49. (Original) The method of claim 47, wherein the smallest scan position included in the first range of scan positions is greater than the smallest scan position included in the second range of scan positions.

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50. (Currently Amended) The method of claim ~~43~~ 27, wherein the threshold function extends over a first range of scan positions, and the given portion is made up of multiple blocks of levels, and the thresholder adjusts the thresholding function by the steps of: partitioning the blocks of the given portion into a first group and a second group of blocks;

associating a second threshold function with the second group, wherein the second threshold function extends over a second range of scan positions;

(a) determining the number of levels (CNT1) beneath the first threshold function;

(b) determining the number of levels (CNT2) beneath the second threshold function;

(c) responsive to the sum of CNT1 and CNT2 being within the predetermined range of the target number (N_{THRESH}), setting the magnitude of the levels beneath the first and second threshold functions to zero;

(d) responsive to the sum of CNT1 and CNT2 being outside of the predetermined range of the target number (N_{THRESH}), transferring a predetermined number of blocks from the first group to the second group; and

responsive to the sum of CNT1 and CNT2 being outside of the predetermined range of the target number (N_{THRESH}), repeating steps (a), (b), (c), and (d) until the sum of CNT1 and CNT2 is within the predetermined range of the target number (N_{THRESH}).

51. (Original) The method of claim 27, wherein the given portion of the frame is a slice of the frame having multiple blocks of levels, and the blocks of levels are thresholded by the thresholder in parallel.